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Kim et al.

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(54) **MAGNET PLATE** 8,686,819 B2 * 4/2014 Schuessler G03F 1/14
335/289
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445/24
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H01F 7/02 (2006.01)

(52) **U.S. Cl.**
CPC **H01F 7/0247** (2013.01)

(58) **Field of Classification Search**
CPC H01L 51/56; C23C 14/50
USPC 335/219, 296
See application file for complete search history.

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(57) **ABSTRACT**

A magnet plate for manufacturing a display device is disclosed. In one aspect, the plate includes at least two magnet units formed in a first direction, each magnet unit including first and second linear motion (LM) guides. The plate also includes a support plate attached to the LM guides. The magnet unit also includes a magnet supporter comprising an upper portion including a magnet coupling part, a lower portion including a plurality of cam followers, and at least two first transfer plate coupling protrusions formed at a predetermined interval. The magnet unit further includes a magnet guide plate placed beneath the magnet supporter and including a guide cam hole into which the cam follower is inserted. The guide cam hole is oblique with respect to the first direction and has a predetermined width such that the cam follower moves within the guide cam hole.

20 Claims, 9 Drawing Sheets

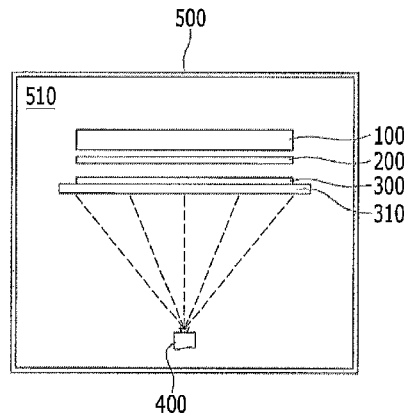


FIG. 1

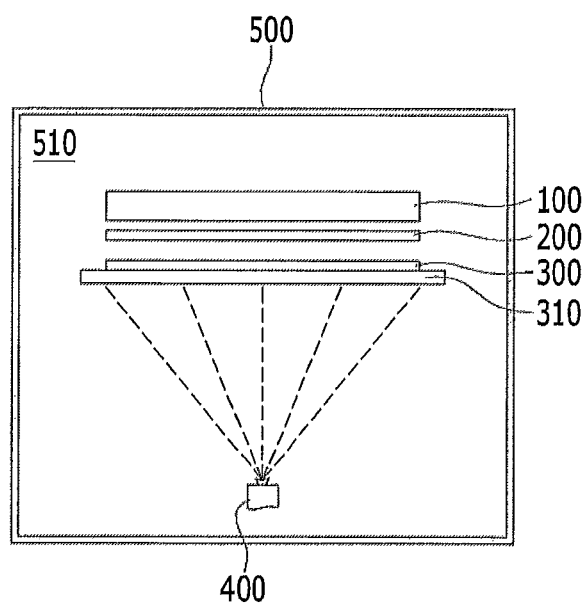


FIG. 2

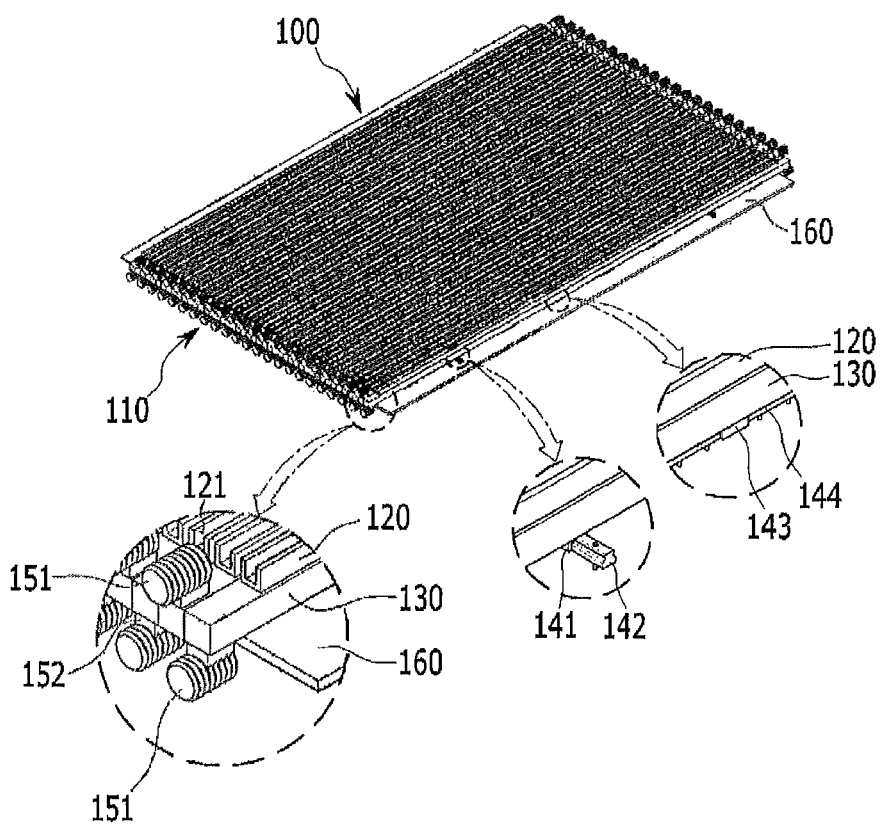


FIG. 3

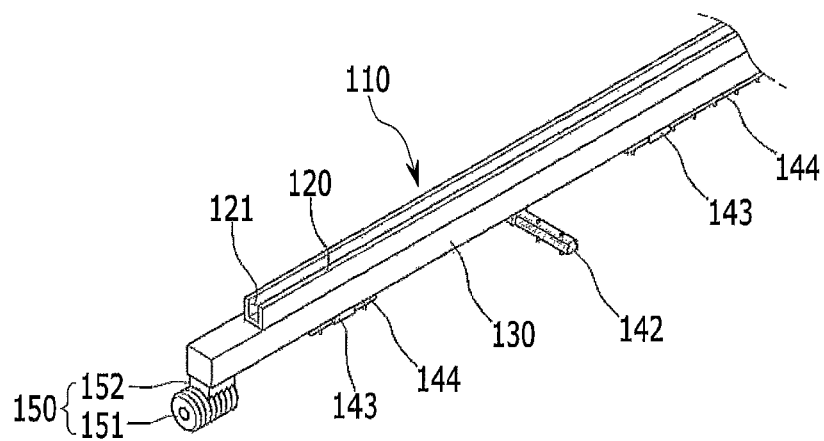


FIG. 4

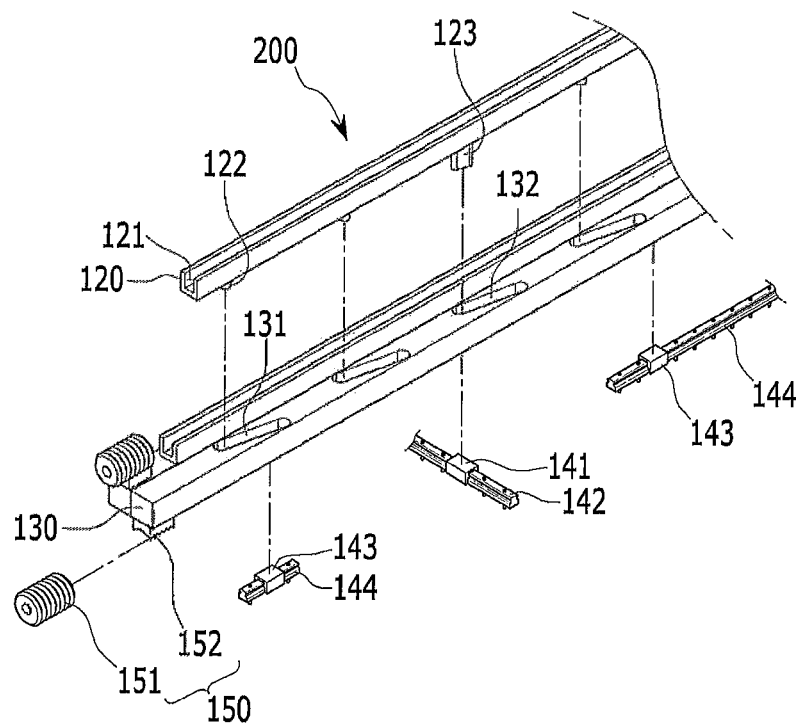


FIG. 5

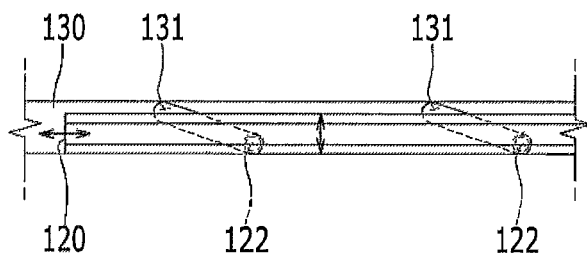


FIG. 6

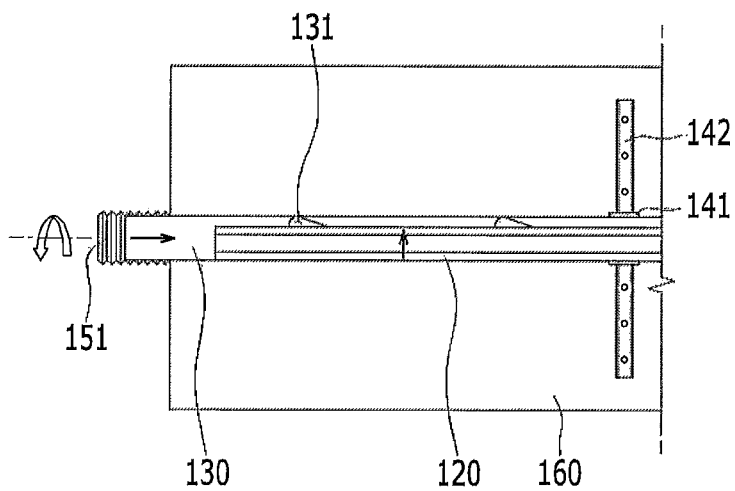


FIG. 7

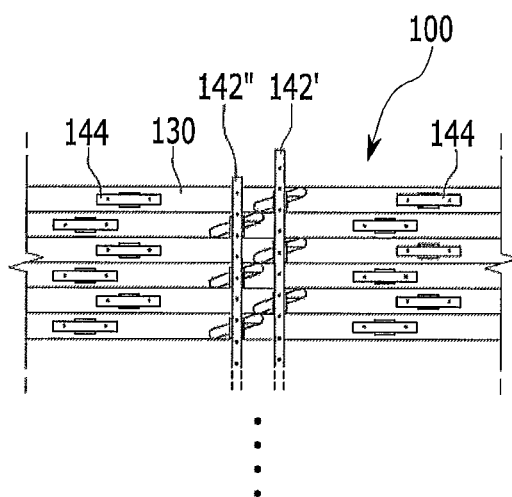


FIG. 8

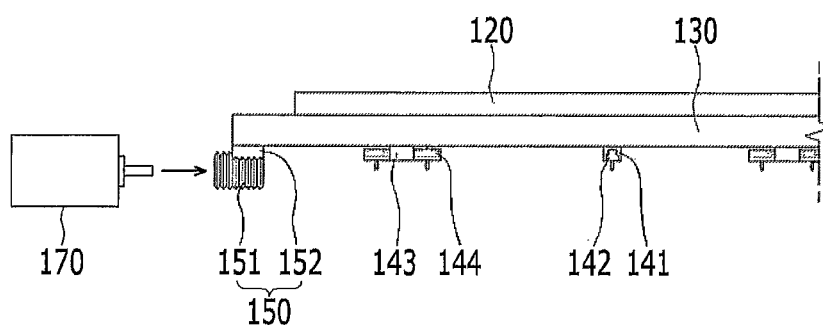
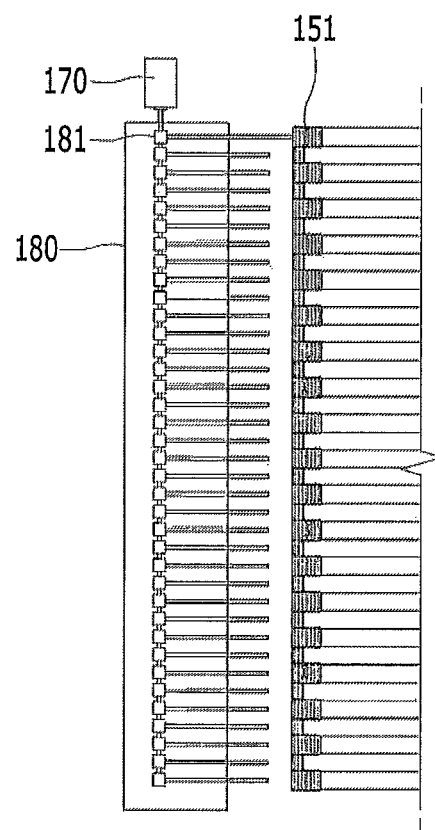


FIG. 9



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MAGNET PLATE**RELATED APPLICATIONS**

This application claims priority to and the benefit of Korean Patent Application No. 10-2015-0010849 filed in the Korean Intellectual Property Office on Jan. 22, 2015, the entire contents of which are incorporated herein by reference.

BACKGROUND**1. Field**

The described technology generally relates to a magnet plate.

2. Description of the Related Technology

An organic light-emitting diode (OLED) display does not have a separate light source (unlike the backlight in a liquid crystal display) and therefore, has a reduced thickness and weight.

In addition, OLED displays have favorable characteristics such as low power consumption, high luminance, high refresh rate, among others.

Generally, OLED displays include an organic layer which includes a substrate and emission layers patterned on the substrate for each pixel.

The organic layer is formed by using an organic layer deposition apparatus which includes a mask placed between a deposition source that evaporates organic material to be deposited on the substrate and the substrate on which the organic material is deposited.

When forming the organic layer as described above, to deposit the organic deposits in a desired area of the substrate, it is important to make the mask adhere to the substrate.

To make the mask adhere to the substrate, a magnet plate is provided facing the mask, having the substrate placed therebetween, in which the magnet plate pulls the mask by a magnetic force, and as a result, the mask adheres to the substrate.

Further, a magnetic field is uniformly formed only in the pulled mask, and thus, it suppresses the deformation of slits within the mask.

SUMMARY OF CERTAIN INVENTIVE ASPECTS

One inventive aspect relates to a position controllable magnet plate for performing a deposition process without replacing the magnet plate even when a mask is changed, by moving a magnet disposed on the magnet plate for each row.

Another aspect is a position controllable magnet plate, comprising: at least two controllable magnet units which are arranged in a row direction; and a support plate fixedly supporting the first LM guide and the second LM guide of the controllable magnet units which are arranged in a row, wherein the controllable magnet unit includes: a magnet support having an upper provided with a magnet coupling part, a lower portion provided with several cam followers and at least two first transfer plate coupling protrusions at a predetermined interval, and extending in a horizontal direction; a magnet guide plate disposed beneath the magnet supporter, provided with a guide cam hole which is inserted with the cam follower and has an oblique form and a predetermined width so that the cam follower moves and a connection hole which communicates with the first transfer plate coupling protrusion and has a predetermined width so that the first transfer plate coupling protrusion moves, and

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extending in a horizontal direction; a first transfer plate coupled with the first transfer plate coupling protrusion penetrating through the connection hole; a first LM guide coupled with a lower portion of the first transfer plate and formed to make the first transfer plate move in a thickness direction of the magnet guide plate; a second transfer plate coupled with a lower portion of the magnet guide plate; a second LM guide coupled with a lower portion of the second transfer plate and formed to make the second transfer plate move in a length direction of the magnet guide plate; and a moving device mounted at a distal end of the magnet guide plate and linearly moving the magnet guide plate.

The first LM guide can include an integrated first LM guide coupled with the first transfer plate of odd-numbered position controllable magnet units which are arranged in a row and an integrated first LM guide coupled with the first transfer plate of even-numbered position controllable magnet units which are arranged in a row.

The moving device can be a rack gear which is mounted at a distal end of the magnet guide plate and a worm gear contacting the rack gear.

The rack gear can be mounted on the upper portion or the lower portion of the magnet guide plate of the odd-numbered controllable magnet units which are arranged in a row and can be mounted on the lower portion or the upper portion of the magnet guide plate of the even-numbered controllable magnet units which are arranged in a row unlike the odd-numbered controllable magnet units, at the distal end of one side of the controllable magnet units which are arranged in a row.

The position controllable magnet plate can further include an actuator connected to the worm gear to apply a torque.

The position controllable magnet plate can further include a plurality of clutches connected to the worm gear and an actuator applying a torque to the plurality of clutches.

The position controllable magnet plate can further include a controller of the actuator or the clutch and can be automatically controlled by the controller.

Another aspect is a magnet plate for manufacturing a display device, comprising: at least two magnet units formed in a first direction, wherein each magnet unit includes first and second linear motion (LM) guides; and a support plate attached to the first and second LM guides. The magnet unit further includes: a magnet supporter comprising i) an upper portion including a magnet coupling part, ii) a lower portion including a plurality of cam followers, and iii) at least two first transfer plate coupling protrusions formed at a predetermined interval, wherein the magnet supporter extends in the first direction; a magnet guide plate placed beneath the magnet supporter and including i) a guide cam hole into which the cam follower is inserted, wherein the guide cam hole is oblique with respect to the first direction and has a predetermined width such that the cam follower moves within the guide cam hole, and ii) a connection hole configured to communicate with the first transfer plate coupling protrusion and has a predetermined width such that the first transfer plate coupling protrusion moves within the connection hole, wherein the magnet guide plate extends in the first direction; a first transfer plate connected to the first transfer plate coupling protrusion penetrating through the connection hole; the first LM guide connected to the first transfer plate and a lower portion of the first transfer plate, wherein the first transfer plate is configured to move along the first LM guide in a second direction crossing the first direction; a second transfer plate connected to a lower portion of the magnet guide plate; the second LM guide connected to the second transfer plate and a lower portion of the second

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transfer plate, wherein the second transfer plate is configured to move along the second LM guide in a third direction crossing the first and second directions; and a moving device mounted at a first end of the magnet guide plate and configured to linearly move the magnet guide plate.

In the above magnet plate, the at least two magnet units include a plurality of odd-numbered magnet units and a plurality of even-numbered magnet units, wherein the first LM guide includes i) a first integrated guide connected to the first transfer plate of at least one of the odd-numbered magnet units and ii) a second integrated guide connected to the first transfer plate of at least one of the even-numbered magnet units.

In the above magnet plate, the moving device includes a rack gear mounted at the first end of the magnet guide plate and a worm gear contacting the rack gear.

In the above magnet plate, the rack gear is mounted on i) the upper portion or the lower portion of the magnet guide plate of the odd-numbered magnet units and ii) the lower portion or the upper portion of the magnet guide plate of the even-numbered magnet units, wherein the upper and lower portions of the magnet guide plate of the odd-numbered magnet units respectively correspond to the lower and upper portions of the magnet guide plate of the even-numbered magnet units.

The above magnet plate further comprises an actuator connected to the worm gear so as to apply a predetermined amount of torque.

The above magnet plate further comprises: a plurality of clutches connected to the worm gear; and an actuator configured to apply a predetermined amount of torque to the clutches.

The above magnet plate further comprises a controller configured to control at least one of the actuator and the clutches.

Another aspect is a magnet plate for manufacturing a display device, comprising: at least two magnet units formed in a first direction and including first and second linear motion (LM) guides. Each magnet unit includes: a magnet supporter comprising i) an upper portion including a magnet coupling part, ii) a lower portion including a plurality of cam followers, and iii) at least two first transfer plate coupling protrusions formed at a predetermined interval, wherein the magnet supporter extends in the first direction; a magnet guide plate placed beneath the magnet supporter and including i) a guide cam hole into which the cam follower is inserted, wherein the guide cam hole is oblique with respect to the first direction and has a predetermined width such that the cam follower moves within the guide cam hole, and ii) a connection hole configured to communicate with the first transfer plate coupling protrusion and has a predetermined width such that the first transfer plate coupling protrusion moves within the connection hole, wherein the magnet guide plate extends in the first direction; a first transfer plate connected to the first transfer plate coupling protrusion penetrating through the connection hole; the first LM guide connected to the first transfer plate and a lower portion of the first transfer plate, wherein the first transfer plate is configured to move along the first LM guide in a second direction crossing the first direction; a second transfer plate connected to a lower portion of the magnet guide plate; the second LM guide connected to the second transfer plate and a lower portion of the second transfer plate, wherein the second transfer plate is configured to move along the second LM guide in a third direction crossing the first and second

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directions; and a moving device mounted at a first end of the magnet guide plate and configured to linearly move the magnet guide plate.

In the above magnet plate, the at least two magnet units include a plurality of odd-numbered magnet units and a plurality of even-numbered magnet units, wherein the first LM guide includes i) a first integrated guide connected to the first transfer plate of at least one of the odd-numbered magnet units and ii) a second integrated guide connected to the first transfer plate of at least one of the even-numbered magnet units.

In the above magnet plate, the moving device includes a rack gear mounted at the first end of the magnet guide plate and a worm gear contacting the rack gear.

In the above magnet plate, the rack gear is mounted on i) the upper portion or the lower portion of the magnet guide plate of the odd-numbered magnet units and ii) the lower portion or the upper portion of the magnet guide plate of the even-numbered magnet units, wherein the upper and lower portions of the magnet guide plate of the odd-numbered magnet units respectively correspond to the lower and upper portions of the magnet guide plate of the even-numbered magnet units.

The above magnet plate further comprises an actuator connected to the worm gear so as to apply a predetermined amount of torque.

The above magnet plate further comprises: a plurality of clutches connected to the worm gear; and an actuator configured to apply a predetermined amount of torque to the clutches.

The above magnet plate further comprises a controller configured to control at least one of the actuator and the clutches.

Another aspect is a magnet plate for manufacturing a display device, comprising: at least two magnet units formed in a first direction. Each magnet unit includes: a magnet supporter comprising i) an upper portion including a magnet coupling part, ii) a lower portion including a plurality of cam followers, and iii) at least two first transfer plate coupling protrusions formed at a predetermined interval, wherein the magnet supporter extends in the first direction; a magnet guide plate placed beneath the magnet supporter and including i) a guide cam hole into which the cam follower is inserted, wherein the guide cam hole is oblique with respect to the first direction and has a predetermined width such that the cam follower moves within the guide cam hole and ii) a connection hole configured to communicate with the first transfer plate coupling protrusion and has a predetermined width such that the first transfer plate coupling protrusion moves within the connection hole, wherein the magnet guide plate extends in the first direction; a first transfer plate connected to the first transfer plate coupling protrusion penetrating through the connection hole; a first LM guide connected to the first transfer plate and a lower portion of the first transfer plate, wherein the first transfer plate is configured to move along the first LM guide in a second direction crossing the first direction; and a moving device mounted at a first end of the magnet guide plate and configured to linearly move the magnet guide plate.

In the above magnet plate, the at least two magnet units include a plurality of odd-numbered magnet units and a plurality of even-numbered magnet units, wherein the first LM guide includes i) a first integrated guide connected to the first transfer plate of at least one of the odd-numbered magnet units and ii) a second integrated guide connected to the first transfer plate of at least one of the even-numbered magnet units.

In the above magnet plate, the moving device includes a rack gear mounted at the first end of the magnet guide plate and a worm gear contacting the rack gear.

In the above magnet plate, the rack gear is mounted on i) the upper portion or the lower portion of the magnet guide plate of the odd-numbered magnet units and ii) the lower portion or the upper portion of the magnet guide plate of the even-numbered magnet units, wherein the upper and lower portions of the magnet guide plate of the odd-numbered magnet units respectively correspond to the lower and upper portions of the magnet guide plate of the even-numbered magnet units.

The above magnet plate further comprises: a plurality of clutches connected to the worm gear; and an actuator configured to apply a predetermined amount of torque to the clutches.

The above magnet plate further comprises a controller configured to control at least one of the actuator and the clutches.

According to at least one of the disclosed embodiments, the operation of replacing the magnet plate can be omitted, there is no need to manufacture the magnet plates for each model to be deposited, the process of destructing the vacuum of the chamber or again making the chamber the vacuum state due to the replacement of the magnet plate can be omitted, thereby preventing the time consumption, improving the productivity, and reducing the deposition costs.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram illustrating a deposition apparatus.

FIG. 2 is a perspective view of a position controllable magnet plate according to an exemplary embodiment.

FIG. 3 is a perspective view of a controllable magnet unit according to an exemplary embodiment.

FIG. 4 is an exploded perspective view of the controllable magnet unit according to the exemplary embodiment.

FIG. 5 is a plan view of an operation structure of a magnet supporter according to an exemplary embodiment.

FIG. 6 is a plan view illustrating an appearance in which one controllable magnet unit according to an exemplary embodiment is coupled to a support plate.

FIG. 7 is a rear view of a row arrangement state of the controllable magnet unit according to an exemplary embodiment.

FIG. 8 is a side view illustrating a moving device of the position controllable magnet plate according to an exemplary embodiment.

FIG. 9 is a schematic plan view illustrating a moving device of a position controllable magnet plate according to an exemplary embodiment.

DETAILED DESCRIPTION OF CERTAIN INVENTIVE EMBODIMENTS

When a model or pattern is changed, the corresponding mask is changed. A magnetic field applied on the changed mask is non-uniform and the position and the shape of the slit within the mask also change. Thus, the resultant thin film deposition pattern may not have the desired position and/or shape.

To prevent this, there is a need to replace the magnet plate corresponding to the mask whenever the model is changed. The operation of replacing the magnet plate includes separating the magnet plate and various structures and reassembling them, and the time expended is a loss in productivity.

Further, the magnet plate needs to be individually manufactured for each model, and therefore, deposition costs can rise. Also, the deposition process needs to be performed inside a chamber to maintain a vacuum state, and therefore, in the case of replacing the magnet plate, the vacuum of the chamber needs to be disassembled. As a result, it takes time to reassemble the chamber a vacuum state and stabilize the deposition rate.

Hereinafter, the described technology will be described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments are shown. As those skilled in the art would realize, the described embodiments can be modified in various different ways, all without departing from the spirit or scope of the described technology.

It is to be noted that the accompanying drawings is schematically illustrated and is not illustrated to a scale. A relative dimension and ratio of components are illustrated being exaggerated or reduced in the drawings for clarity and convenience in the drawings and any dimension is only an example and therefore is not limited thereto. Further, the same structures, elements, or parts which are illustrated in at least two drawings are denoted by the same reference numerals, which is used to indicate similar features. The mention that any portion is present "over" or "on" another portion device that any portion can be directly formed on another portion or a third portion can be interposed between one portion and another portion.

An exemplary embodiment will be described in detail. As the result, numerous variations of exemplary embodiments are expected. Therefore, the exemplary embodiments are not limited to a specific form of the illustrated region and, for example, also include a form changed by manufacturing.

Hereinafter, a position controllable magnet plate according to an exemplary embodiment will be described in detail with reference to FIG. 1. In this disclosure, the term "substantially" includes the meanings of completely, almost completely or to any significant degree under some applications and in accordance with those skilled in the art.

FIG. 1 is a schematic diagram illustrating a deposition apparatus.

As illustrated in FIG. 1, a deposition apparatus includes a chamber 500 which is operated at a predetermined temperature, in which any one end of an upper portion or a lower portion in the chamber 500 is provided with a deposition source 400 in which organic deposits are accommodated. An opposite side of the deposition source 400 is provided with a substrate 200, having an assembly of a mask 300 and a frame 310 interposed therebetween.

A position controllable magnet plate 100 according to an exemplary embodiment is provided to face the assembly of the mask 300 and the frame 310, having the substrate placed therebetween. The position controllable magnet plate 100 pulls the mask 300 by a magnetic force to make the mask 300 adhere to the substrate 200.

In depositing the organic deposits on the substrate 200 by the deposition apparatus, after an inner space 510 of the chamber 500 is maintained in a vacuum state having a predetermined vacuum degree and is maintained at a predetermined temperature greater than a room temperature, the organic deposits are evaporated or sublimated from the deposition source 400 to be deposited on the substrate 200 through the mask 300.

Generally, the magnet plate uniformly forms a magnetic field on the mask to suppress a deformation of a slit within the mask. However, generally even when the mask 300 is changed according to a change in a deposited model (or

deposited pattern), and the like, the position controllable magnet plate **100** according to the exemplary embodiment can substantially uniformly form the applied magnetic field in response to the changed mask.

This can be implemented by making the magnet supporter **120** vertically move on upper portions of the controllable magnet units **110** which are arranged in a row.

Hereinafter, this will be described in detail.

FIG. **2** is a perspective view of a position controllable magnet plate according to an exemplary embodiment.

As illustrated in FIG. **2**, the position controllable magnet plate **100** according to the exemplary embodiment includes a plurality of controllable magnet units **110** which are arranged in a row, and a support plate **160**.

The controllable magnet units **110** are fixed to the support plate **160** by first and second linear motion (LM) guides **142** and **144** and first and second transfer plates **141** and **143** which are components thereof.

The controllable magnet unit **110** can include a worm gear **151** and a rack gear **152** which are a moving device **150**, in which the worm gear **151** and the rack gear **152** can be provided on the upper portion or the lower portion of the controllable magnet units **110** which are arranged in a row. The worm gear **151** and the rack gear **152** can intersect each other and these gears **151** and **152** will be described in detail with reference to FIG. **4**.

FIG. **3** is a perspective view of a controllable magnet unit according to an exemplary embodiment. FIG. **4** is an exploded perspective view of the controllable magnet unit according to the exemplary embodiment.

The controllable magnet unit **110** according to the exemplary embodiment includes a magnet supporter **120**, a magnet guide plate **130**, an assembly of the first transfer plate **141** and the first LM guide **142**, an assembly of the second transfer plate **143** and the second LM guide **144**, and the moving device **150**.

The magnet supporter **120** extends in a horizontal direction and an upper portion of the magnet supporter **120** is provided with predetermined grooves. The grooves form a magnet coupling part (or magnetic coupling portion) **121**, in which the magnet coupling part **121** is coupled to a magnet (not illustrated).

A lower portion of the magnet supporter **120** is provided with several cam followers **122** which are inserted into guide cam holes **131** of the magnet guide plate **130**.

Further, the lower portion of the magnet supporter **120** is provided with at least two first transfer plate coupling protrusions **123** at a predetermined interval. The first transfer plate coupling protrusions **123** are coupled to the first transfer plate **141**.

The lower portion of the magnet supporter **120** is provided with the magnet guide plate **130**.

The magnet guide plate **130** is provided with the guide cam hole **131** into which the cam follower **122** is inserted.

The guide cam hole **131** has a predetermined width and is oblique with respect to a thickness direction of the magnet guide plate **130**.

The magnet guide plate **130** is provided with a connection hole **132** with which the first transfer plate coupling protrusion **123** of the magnet supporter **120** communicates.

The connection hole **132** has a width large enough to move the first transfer plate coupling protrusion **123** freely in the guide cam hole **131** of the cam follower **122**.

The lower portion of the magnet guide plate **130** is provided with the first transfer plate **141** which is coupled to the first transfer plate coupling protrusion **123** penetrating through the connection hole **132**.

Further, the lower portion of the first transfer plate **141** is coupled to the first LM guide **142** which is formed to enable the first transfer plate **141** to move in the thickness direction of the magnet guide plate **130**.

The lower portion of the magnet guide plate **130** is coupled to the second transfer plate **143**.

Further, the lower portion of the second transfer plate **143** is coupled to the second LM guide **144** which is formed to enable the second transfer plate **143** to move in a length direction of the magnet guide plate **130**.

A distal end of the magnet guide plate **130** is provided with the moving device **150** by which the magnet guide plate **130** linearly moves in the length direction of the magnet guide plate **130**.

The moving device **150** can include the worm gear **151** and the rack gear **152**.

The rack gear **152** is coupled to the distal end of the magnet guide plate **130** and an opposite side of the coupled portion is formed with threads.

The worm gear **151** which is formed with threads corresponding to the threads of the rack gear **151** is disposed to contact the rack gear **152**.

Meanwhile, the rack gear **152** can be mounted on the upper portion or the lower portion of the magnet guide plate **130**.

When a diameter of the worm gear **151** is formed to be large, a contact area of the worm gear **151** and the rack gear **152** is greater than when the diameter of the worm gear **151** is formed to be small to increase a friction force between the worm gear **151** and the rack gear **152**. Therefore the diameter of the worm gear **151** can be formed to be as large as a predetermined numerical value.

Meanwhile, when the diameter of the worm gear **151** is formed to be large as described above, the diameter of the worm gear **151** is larger than a numerical value of the thickness of the magnet guide plate **130**. Therefore the problem of the controllable magnet units **110** not being arranged in a row while contacting each other can occur. As a result, the rack gear **152** of one side of the controllable magnet units **110** which are arranged in a row, while being adjacent to each other, can be mounted on the magnet guide plate **130**, and the rack gear **152** of the other side of the controllable magnet units **110** can be mounted beneath the magnet guide plate **130**.

Hereinafter, an operation structure of the magnet supporter **120** of the position controllable magnet plate **100** will be described in detail.

FIG. **5** is a plan view of an operation structure of a magnet supporter according to an exemplary embodiment.

As illustrated in FIG. **5**, the cam hole follower **122** of the magnet supporter **120** is inserted into the guide cam hole **131** of the magnet guide plate **130**. Therefore, when the magnet supporter **120** can move only in a vertical direction and the magnet guide plate **130** can move only in a horizontal direction, the magnet supporter **120** moves in a vertical direction based on the horizontal movement of the magnet guide plate **130**.

FIG. **6** is a plan view illustrating an appearance in which one controllable magnet unit according to an exemplary embodiment is coupled to a support plate.

First, the magnet supporter **120** is coupled to the assembly of the first transfer plate **141** and the first LM guide **142** by the first transfer plate coupling protrusion **123** and the first LM guide **142** is fixedly supported to the support plate **160**.

By this configuration, the magnet supporter **120** can move only in the thickness direction of the magnet guide plate **130**, that is, only in the vertical direction in FIG. **6**.

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Next, the magnet guide plate **130** is coupled to the assembly of the second transfer plate **143** and the second LM guide **144**. The second LM guide **142** is fixed to the support plate **160**.

By this configuration, the magnet guide plate **130** can move in the length direction of the magnet guide plate **130**, that is, only in the horizontal direction in FIG. 6.

In the state as described above, as illustrated in FIG. 6, when the worm gear **151** rotates counterclockwise, the magnet guide plate **130** moves in a right direction based on the rack gear **152** which is mounted at the distal end of the magnet guide plate **130**. Thus, the magnet supporter **120** moves upwardly.

When the worm gear **151** rotates clockwise, the magnet guide plate **130** moves in a left direction, and thus the magnet supporter **120** moves downward.

That is, the magnet supporter **120** can move vertically and the magnet coupled to the magnet supporter **120** can also move vertically.

FIG. 7 is a rear view of a row arrangement state of the controllable magnet unit according to the exemplary embodiment, in which the support plate **150** is not illustrated.

As illustrated in FIG. 7, the first LM guide **142** includes an integrated first LM guide (or first integrated guide) **142'** which is coupled to the first transfer plate **141** of odd-numbered position controllable magnet units **110** which are arranged in a row and an integrated first LM guide (or second integrated guide) **142''** which is coupled to the first transfer plate **141** of even-numbered position controllable magnet units **110** which are arranged in a row.

FIG. 8 is a side view illustrating a moving device of the position controllable magnet plate according to an exemplary embodiment. FIG. 9 is a schematic plan view illustrating a moving device of a position controllable magnet plate according to another exemplary embodiment.

First, as illustrated in FIG. 8, individual controllable magnet units **110** are automatically operated by an actuator **170** which is connected to the worm gear **151** to apply a torque.

The actuator **170** which can apply enough torque and can be implemented by a general device, and therefore a description thereof will be omitted.

In addition, it is possible to manually rotate the worm gear **151** using a driver, a hexagonal wrench, or the like.

Next, as illustrated in FIG. 9, the moving device includes a gear box **180** provided with a plurality of clutches **181** which are connected to the individual worm gears **151** and the actuator **170** which applies rotary power to the clutches **181**. The clutch **181** transfers the torque of the actuator **170** to the worm gear **151** to automatically operate the individual controllable magnet units **110**.

Further, the position controllable magnet plate **100** includes a controller which automatically controls the actuator **170** or the clutch **181**, and the operation of the position controllable magnet unit **110** can be automatically controlled by the controller.

While the inventive technology has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the inventive technology is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. A magnet plate for manufacturing a display device, comprising:

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at least two magnet units formed in a first direction, wherein each magnet unit includes first and second linear motion (LM) guides; and

a support plate attached to the first and second LM guides, wherein the magnet unit further includes:

a magnet supporter comprising i) an upper portion including a magnet coupling part, ii) a lower portion including a plurality of cam followers, and iii) at least two first transfer plate coupling protrusions formed at a predetermined interval, wherein the magnet supporter extends in the first direction;

a magnet guide plate placed beneath the magnet supporter and including i) a guide cam hole into which the cam follower is inserted, wherein the guide cam hole is oblique with respect to the first direction and has a predetermined width such that the cam follower moves within the guide cam hole, and ii) a connection hole configured to communicate with the first transfer plate coupling protrusion and has a predetermined width such that the first transfer plate coupling protrusion moves within the connection hole, wherein the magnet guide plate extends in the first direction;

a first transfer plate connected to the first transfer plate coupling protrusion penetrating through the connection hole;

the first LM guide connected to the first transfer plate and a lower portion of the first transfer plate, wherein the first transfer plate is configured to move along the first LM guide in a second direction crossing the first direction;

a second transfer plate connected to a lower portion of the magnet guide plate;

the second LM guide connected to the second transfer plate and a lower portion of the second transfer plate, wherein the second transfer plate is configured to move along the second LM guide in a third direction crossing the first and second directions; and

a moving device mounted at a first end of the magnet guide plate and configured to linearly move the magnet guide plate.

2. The magnet plate of claim 1, wherein the at least two magnet units include a plurality of odd-numbered magnet units and a plurality of even-numbered magnet units, and wherein the first LM guide includes i) a first integrated guide connected to the first transfer plate of at least one of the odd-numbered magnet units and ii) a second integrated guide connected to the first transfer plate of at least one of the even-numbered magnet units.

3. The magnet plate of claim 1, wherein the moving device includes a rack gear mounted at the first end of the magnet guide plate and a worm gear contacting the rack gear.

4. The magnet plate of claim 3, wherein the rack gear is mounted on i) the upper portion or the lower portion of the magnet guide plate of the odd-numbered magnet units and ii) the lower portion or the upper portion of the magnet guide plate of the even-numbered magnet units, and wherein the upper and lower portions of the magnet guide plate of the odd-numbered magnet units respectively correspond to the lower and upper portions of the magnet guide plate of the even-numbered magnet units.

5. The magnet plate of claim 3, further comprising an actuator connected to the worm gear so as to apply a predetermined amount of torque.

6. The magnet plate of claim 3, further comprising: a plurality of clutches connected to the worm gear; and

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an actuator configured to apply a predetermined amount of torque to the clutches.

7. The magnet plate of claim 6, further comprising a controller configured to control at least one of the actuator and the clutches.

8. A magnet plate for manufacturing a display device, comprising:

at least two magnet units formed in a first direction and including first and second linear motion (LM) guides, wherein each magnet unit includes:

a magnet supporter comprising i) an upper portion including a magnet coupling part, ii) a lower portion including a plurality of cam followers, and iii) at least two first transfer plate coupling protrusions formed at a predetermined interval, wherein the magnet supporter extends in the first direction;

a magnet guide plate placed beneath the magnet supporter and including i) a guide cam hole into which the cam follower is inserted, wherein the guide cam hole is oblique with respect to the first direction and has a predetermined width such that the cam follower moves within the guide cam hole, and ii) a connection hole configured to communicate with the first transfer plate coupling protrusion and has a predetermined width such that the first transfer plate coupling protrusion moves within the connection hole, wherein the magnet guide plate extends in the first direction;

a first transfer plate connected to the first transfer plate coupling protrusion penetrating through the connection hole;

the first LM guide connected to the first transfer plate and a lower portion of the first transfer plate, wherein the first transfer plate is configured to move along the first LM guide in a second direction crossing the first direction;

a second transfer plate connected to a lower portion of the magnet guide plate;

the second LM guide connected to the second transfer plate and a lower portion of the second transfer plate, wherein the second transfer plate is configured to move along the second LM guide in a third direction crossing the first and second directions; and

a moving device mounted at a first end of the magnet guide plate and configured to linearly move the magnet guide plate.

9. The magnet plate of claim 8, wherein the at least two magnet units include a plurality of odd-numbered magnet units and a plurality of even-numbered magnet units, and wherein the first LM guide includes i) a first integrated guide connected to the first transfer plate of at least one of the odd-numbered magnet units and ii) a second integrated guide connected to the first transfer plate of at least one of the even-numbered magnet units.

10. The magnet plate of claim 8, wherein the moving device includes a rack gear mounted at the first end of the magnet guide plate and a worm gear contacting the rack gear.

11. The magnet plate of claim 10, wherein the rack gear is mounted on i) the upper portion or the lower portion of the magnet guide plate of the odd-numbered magnet units and ii) the lower portion or the upper portion of the magnet guide plate of the even-numbered magnet units, and wherein the upper and lower portions of the magnet guide plate of the odd-numbered magnet units respectively correspond to the lower and upper portions of the magnet guide plate of the even-numbered magnet units.

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12. The magnet plate of claim 10, further comprising an actuator connected to the worm gear so as to apply a predetermined amount of torque.

13. The magnet plate of claim 10, further comprising: a plurality of clutches connected to the worm gear; and an actuator configured to apply a predetermined amount of torque to the clutches.

14. The magnet plate of claim 13, further comprising a controller configured to control at least one of the actuator and the clutches.

15. A magnet plate for manufacturing a display device, comprising:

at least two magnet units formed in a first direction, wherein each magnet unit includes:

a magnet supporter comprising i) an upper portion including a magnet coupling part, ii) a lower portion including a plurality of cam followers, and iii) at least two first transfer plate coupling protrusions formed at a predetermined interval, wherein the magnet supporter extends in the first direction;

a magnet guide plate placed beneath the magnet supporter and including i) a guide cam hole into which the cam follower is inserted, wherein the guide cam hole is oblique with respect to the first direction and has a predetermined width such that the cam follower moves within the guide cam hole and ii) a connection hole configured to communicate with the first transfer plate coupling protrusion and has a predetermined width such that the first transfer plate coupling protrusion moves within the connection hole, wherein the magnet guide plate extends in the first direction;

a first transfer plate connected to the first transfer plate coupling protrusion penetrating through the connection hole;

a first LM guide connected to the first transfer plate and a lower portion of the first transfer plate, wherein the first transfer plate is configured to move along the first LM guide in a second direction crossing the first direction; and

a moving device mounted at a first end of the magnet guide plate and configured to linearly move the magnet guide plate.

16. The magnet plate of claim 15, wherein the at least two magnet units include a plurality of odd-numbered magnet units and a plurality of even-numbered magnet units, and wherein the first LM guide includes i) a first integrated guide connected to the first transfer plate of at least one of the odd-numbered magnet units and ii) a second integrated guide connected to the first transfer plate of at least one of the even-numbered magnet units.

17. The magnet plate of claim 15, wherein the moving device includes a rack gear mounted at the first end of the magnet guide plate and a worm gear contacting the rack gear.

18. The magnet plate of claim 17, wherein the rack gear is mounted on i) the upper portion or the lower portion of the magnet guide plate of the odd-numbered magnet units and ii) the lower portion or the upper portion of the magnet guide plate of the even-numbered magnet units, and wherein the upper and lower portions of the magnet guide plate of the odd-numbered magnet units respectively correspond to the lower and upper portions of the magnet guide plate of the even-numbered magnet units.

19. The magnet plate of claim 17, further comprising: a plurality of clutches connected to the worm gear; and

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an actuator configured to apply a predetermined amount of torque to the clutches.

20. The magnet plate of claim **19**, further comprising a controller configured to control at least one of the actuator and the clutches.

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